

Section II – Technical Specifications				
Tender enquiry no. : STDS/12-1/2016-17/PUR/STL/A-1848				
Technical Specification for Series Resonant Transformer with Partial Discharge Measurement System				
<b>1.0 SCOPE</b> The scope of supply covers design, manufacture, testing, supply, installation and commissioning of Series Resonant Transformer with Partial Discharge Measurement System for STDS, CPRI, Bhopal.				
<b>2.0 APPLICATION</b> Series Resonant Transformer (SRT) with Partial Discharge (PD) Measurement System shall be used for Power frequency voltage withstand & flashover tests (dry), measurement of Partial Discharge and Radio Interference Voltage (RIV) tests on current transformers, Voltage transformers, Capacitive voltage transformers, Bushings, Cables, Transformers, Circuit breakers, Disconnectors and other high voltage equipments of voltage rating upto 400kV class as per relevant IS, IEC, IEEE etc. standards.				
<b>3.0 Detailed Specification :</b> The Series Resonant Test system shall be designed to provide rated test power at specified voltages and partial discharge levels for high voltage testing of capacitive test objects. The Series Resonant Test system with Partial Discharge Measurement system shall comprise of all the necessary test, measurement, control, protection system along with associated accessories to demonstrate its capability to meet the general specification. The high voltage Series Resonant Test and its measurement system shall meet the requirement of IEC 60060-1 & IEC 60060-2 and Partial Discharge measurement system shall meet the requirements of IEC60270 standard for PD measurements and NEMA 107/ ANSI C63.2-1996/CISPR 18-2 standards for RIV tests. The offer shall be for the comprehensive system including erection and commissioning of the whole system including training of CPRI personnel. The general requirements and specifications of various components of the system are given below in the tabular format which shall be filled and submitted by the bidders along with the offer.				
<b>Note:</b> The Offers should be submitted only in this format otherwise the offer will be liable for rejection. A detailed technical catalogue / literature / pamphlet and any other technical details shall be sent in hard copy in a sealed cover super scribing enquiry number and due date so as to reach the following address within the due date and time. This is very much essential to evaluate your offer. The item to be delivered at Switchgear Testing and Development Station, Bhopal				
Name of the Vendor :				
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		<b>TECHNICAL SPECIFICATIONS</b>	Guaranteed Technical Particulars (GTP)	Deviation/Remarks specify if any
3.1		<b>Environment and Operating conditions:</b>  Complete system shall work satisfactorily under following environment and operating conditions: a) Installation : Indoor b) Ambient temperature : 5 °C to 40 °C, Average: 30°C c) Altitude : <1000 m above MSL d) Relative humidity: 10 to 90 % (non-condensing) e) Power Supply : 415V±10%, 3-Phase, 4-wire, 50 Hz		
3.2		<b>Series Resonant Test System :</b>  General Specification Mode of Operation: Series resonant Total Output Voltage : 0-800 kVrms Max. Load current: 3A Maximum Test Power :2400 kVA Duty Cycle: 30 min ON / 30 min OFF Maximum PD level : ≤ 2pC @ 400kV and ≤ 5pC @ 800kV		

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		<p>The High voltage series resonant system shall be supplied with all the necessary components for generation &amp; measurement of test voltage, control &amp; protection of the test system, display &amp; storage of data, routine tests on the components, performance tests on the total tests and measuring system etc in compliance with the IEC standard 60060-1 and 60060-2. The whole test system shall comply with IEC 60060-1 and IEC60060-2.</p> <p>The series resonant test system include the following main components :</p> <p>i). Double Shielded Isolation Transformer  ii). Regulating Transformer  iii). Exciter Transformer  iv). High Voltage Reactor  v). Capacitive Voltage Divider  vi). Low Voltage Filter  vii). Measuring Instrument, System and control panel  viii). Measurement Instrument (RIV system)  ix). Software  x). Accessories and spares</p>		
3.2.1		<p><b>Double Shielded Isolation Transformer (DSIT):</b>  Double shielded isolation transformer shall be designed to provide isolation of the test system from the mains and reduce the coupling of high frequency noise between the mains and test power source. The base frame of double shielded isolation transformer shall be fitted with high quality caster wheels with locking mechanism for easy movement on smooth platform.</p>		
3.2.2		<p><b>Regulating Transformer (RT):</b>  The regulating transformer shall be provided with "zero start" interlock so that the regulating transformer always starts at zero voltage.  It shall be over current and short circuit protected.  The base frame of regulating transformer shall be fitted with high quality castor wheels with locking mechanism for easy movement on smooth platform.  Type: Indoor  Input : 415V, 50Hz, 2-Ph  Output : 0 - 415V, 50Hz  Rated KVA: 60 KVA or higher  Cooling class : ONAN/AN</p>		
3.2.3		<p><b>Exciter Transformer (ET)</b>  The exciter transformer shall be designed to set up the mains voltage and provide real power losses present in the high voltage series resonant circuit. It shall also provide isolation between the mains connected primary and the high voltage circuit in the secondary. Multiple taps shall be provided to maximize the operating load range of the system. The taps must be selectable through motorized system. The transformer shall be protected with suitable arresters. The exciter shall be fitted with suitable voltage and current measurements for tuning the circuitry.</p> <p>Input : 415V, 50Hz, 2-Ph  Output : 0-415V, 50Hz  Rated Power: 60 KVA or higher  Cooling class : ONAN/AN  Tap configuration: To be specified with output voltage and output current.</p>		
3.2.4		<p><b>High Voltage Reactor (HVR):</b>  The high voltage reactor shall be oil insulated and modular in construction for cascading. The high voltage reactor modules shall be designed to withstand electro-magnetic forces and transient voltage stresses due to external breakdowns. The air-gaps shall be variable so as to allow continuous adjustment of the inductance of the reactor. The gap variation shall be motorized with high precision mechanism to allow variable drive speed for the full range of inductance adjustment for precise tuning. Safety systems to protect the gap drive mechanism from damages shall be provided. The high voltage modules shall be equipped with high voltage electrodes for corona free operation at the specified voltages. The base frame of high voltage reactor modules shall be fitted with high quality caster wheels with locking mechanism for easy movement on smooth platform.</p> <p>Rated voltage : 800kVrms  Operating frequency : 50Hz  Rated Maximum Power ≥2400 KVA</p>		

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3.2.5		<b>Capacitive Voltage Divider with blocking impedance</b> Capacitive Voltage Divider (CVD) The capacitive divider shall be Oil insulated and hermetically sealed capacitor in FRP housing mounted on mobile platform and suitable corona free HV electrodes. HV divider shall be fitted with suitable rugged design wheels for smooth movement of the divider. The high voltage electrode provided shall be dimensioned for suitably connecting the blocking impedance alongwith coupling capacitor and shall be PD free. Type : Capacitor Rated Voltage : 800 kV Rated Capacitance: 1000pF or Higher Accuracy: $\leq \pm 1\%$ P.D. Level: $\leq 2\text{pC}$ at 800 kVrms		
		The capacitive divider shall be connected continuously to the series resonant test system for the measurement of AC voltage in separate source HV test and partial discharge tests. Suitable secondary arm, Co-axial measuring cable of 50 m length with matching cable connectors shall be provided. Mobility: The base frame capacitive voltage divider shall be fitted with high quality castor wheels with locking mechanism for easy movement on smooth platform.		
		<b>Blocking Impedance:</b> Blocking impedance shall also be PD free and shall be provided with an internal spark gap to protect the HV source incase of failure of the test object against high energy steep front voltages.		
3.2.6		<b>Low Voltage Filter (LVF):</b>  Input filter shall be designed to attenuate electrical noise in the PD measurement band which may be introduced by the mains into the HV test circuit. The filters shall behave as passive networks consisting of inductors and shunt capacitors. The filter configuration must be such that it provides low pass characteristic to minimize pass band loss and maximize high frequency attenuation.		
3.2.7		<b>Measuring Instrument (MI):</b> The Low Voltage output from secondary arm of CVD may be transmitted to the measuring instrument module. In case of the voltage measuring instrument forms as an integral part and embedded into the computer based system, the overall measuring system shall meet the requirements of IEC 60060-1 & 2. The Measuring Instrument, if provided separately, shall meet the following requirements.  Input Voltage: Compatible with divider output voltage Protection: Surge protection to be provided Display/Setting: In built along with control panel or can be independent. Aux. AC voltage: 230V $\pm 10\%$ , 50Hz		
3.2.7.1		<b>Operating System and Control Panel:</b>  The operating system and control panel for the series resonant test system shall have all the necessary controls, indicators and measuring systems required by the operator to easily and safely perform the tests. The computer assisted operation of series resonant type AC high voltage test system shall be provided with ease of control and built in safety interlocks for the test system. The system should have a high electromagnetic compatibility. The display shall be wide and presentable for ease of monitor and settings. The control desk shall have high quality wheels with locking mechanism for ease of movement.  The following features shall be provided - ON/OFF Switch of the primary circuit breaker - High voltage on/off switch - Automatic zero start-up after switch of the high voltage - Switch for tuning of the high voltage reactor - Emergency OFF - Any other control for functioning of the test system to meet the requirement of reference standards.		

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3.2.7.2		<p><b>Safety and protective function :</b></p> <ul style="list-style-type: none"> <li>- After flashover or breakdown in the test circuit, the input circuit breaker shall be immediately opened.</li> <li>- After every shut-down of the test system the regulating transformer shall be reset to the initial position.</li> <li>- A lockable emergency switch shall be built into a separate case so that the switch can be placed as needed.</li> </ul> <p>External Safety Devices :</p> <p>Provisions shall be made on the control desk to connect the following external devices :</p> <ul style="list-style-type: none"> <li>• Safety loop to connect external emergency switches</li> <li>• Safety loop to control the safety fences</li> <li>• Warning lamps to signal operating conditions.</li> </ul> <p>GREEN : Ready for operation, Main switch ON RED : Operating primary and secondary ON.</p>		
3.2.7.3		<p><b>Metering/Display</b></p> <p>All the meters used for voltage or current shall be digital and shall have <math>\pm 1\%</math> class or better accuracy. The meters shall be easily accessible and calibrated.</p> <p>Aux. AC supply voltage : 240Vac <math>\pm 10\%</math>, 50Hz. Acc. Class : <math>\pm 1\%</math> class or better</p> <ol style="list-style-type: none"> <li>1. Output Current Ammeter (AC)</li> <li>2. Digital Exciter Voltage</li> <li>3. Input current meter</li> <li>4. Input voltages</li> <li>5. Timer</li> <li>6. Any other meter/display for functioning of the test system. (Resonance point, frequency, etc)</li> </ol> <p>In case of computer based control and display system, the parameters can be provided as virtual display on the operator panel with high impact visual effect.</p>		
3.2.7.4		<p><b>Partial Discharge Measuring system</b></p> <p>Partial Discharge Measuring and Analyzing system is intended to measure, record, analyze and interpret partial discharges from high voltage equipment. It shall meet the following requirements;</p> <ol style="list-style-type: none"> <li>a. Measurement of apparent charge</li> <li>b. PD quality tests on high voltage equipment</li> <li>c. PD diagnosis and</li> <li>d. Radio Interference Voltage (RIV) measurements</li> </ol> <p>The equipment system shall include the following components</p> <ul style="list-style-type: none"> <li>- Digital Partial Discharge Detector with Analyzing Software</li> <li>- Coupling capacitor with blocking impedance</li> <li>- Coupling Device (Quadripole) for partial discharge measurement</li> <li>- Partial Discharge Calibrator</li> <li>- Measuring impedance and Additional module for RIV measurement (match with coupling capacitor)</li> </ul>		

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3.2.7.4.1		<b>Digital Partial Discharge Measuring System:</b>  General Requirements: The Digital PD measurement and Analyzing shall have the following basic technical features and shall comply with IEC 60270 (latest version), ANSI C63.2-1996 (latest version) and other standards for high voltage test and measurement technology including ICEA T-24-380 standard for cable. The PD measuring system shall be complete in all respect with dedicated software for acquisition and analysis of the data measuring and any other essential and necessary accessories. The equipment shall have computer aided measuring, recording, storing, monitoring and analysis of PD pulses and suitable for fundamental PD studies in research and quality assurance testing. Operating condition Operating temp. : 5 °C to 40 °C Relative humidity : 20% to 90% Input voltage : 230Vac ±10% Frequency : 50Hz ±1.5 Hz EMC : Compliance as per relevant International standards Safety : Shock and vibration proof as per relevant International standards Hardware ( PD measurements) Minimum requirement for measurement of parameters with digital PD Instrument : As per Cl. 4.4 of IEC 60270/2000 Maximum detectable apparent charge: 1000 pC or higher (with auto ranging feature)		
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		Input impedance : 50 Ohms Minimum detectable apparent charge : < 1pC (@ 50 Ohms Input Impedance) Resolution : 0.1 pC Input : From quadripole as per Clause 4.3.2 of IEC 60270 (compatible with coupling capacitor 1nF or higher) Pulse Train response: Compliance to Cl. 4.3.3 of IEC 60270/2000. PD system bandwidth :30kHz – 400kHz for Wide Band ( as per Clause 4.3.4 ) Wide band with active integrator ( as per Clause 4.3.5) / 50 kHz – 1MHz ( as per Clause 4.3.65) for Narrow band Pulse resolution time: 10µs or better Derived quantities measurement: Pulse repetition rate (n), Pulse repetition frequency (N), Average Discharge current (I) etc as per CL. 4.5 of IEC 60270		
3.2.7.5		<b>Coupling device - Quadripole for partial discharge measurement :</b>  The Coupling device used for PD measurement shall be a passive device which converts high input current to convenient output voltage signal and transmitted to measuring instrument by a suitable coaxial cable. The device shall have proper terminations for ease of connections. The device shall fulfil the following requirement of IEC and ANSI standards for PD measurements: Operating Temperature : 5 to 40°C Relative humidity : 20 % to 90% Bandwidth : ≥10 MHz Protection : Built in Overvoltage protection Input Isolation : >500V Voltage measurement : With additional Low voltage capacitor and coupling capacitor (Voltage measurement shall comply to IEC 60060-2)		
3.2.7.6		<b>Partial Discharge Calibrator :</b> The PD calibrator shall meet the technical requirements as per Clauses 6.2 and 6.3 of IEC 60270/200 for calibration of a measuring system in the complete test circuit and performance tests on measuring systems respectively. The calibrator shall have the following minimum features: Partial Discharge range : 5,20,50,200 & 500pC ( in convenient steps) Discharge tolerance: ±5%, ±1 pC Rise time: < 60nsec Pulse resolution time: 10 µs approx... Polarity : Positive / Negative for Full range and Bipolar ( up to 500pC atleast) Power : Mains Powered /Rechargeable Battery with battery charger Cable : Suitable length cable with connectors. Calibration : Provision of external terminals for measurement of capacitance and pulse magnitude		

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3.2.8.1		<b>Hardware ( RIV Measurements)</b>  The PD measuring system shall have the capability ( with or without additional hardware and processing software) to measure RIV level according to NEMA standard 107, ANSI C63.2-1996, ANSI C63.4-1981, CISPR 18-2 standards. The RIV measuring system shall meet the following technical requirements: FrequencyRange: 800kHz – 1.2 MHz Input Impedance : 50 $\Omega$ Bandwidth : 9 KHz		
3.2.8.2		<b>Coupling Device (RIV):</b> Suitable matching Impedance box(s) ( compliance to reference standards) with built in over voltage protection (for RIV measurement at 500kHz and 1000kHz @ 300 $\Omega$ considering Coupling capacitor of 1nF) along with 50 $\Omega$ coaxial cable of 50m length.		
3.2.9		<b>Software and other features;</b> - Display of PD and test voltage - Display RIV level - Laptop with Windows operating system - Software for computer aided measuring, recording, storing, monitoring and analysis of PD pulses - Additional analyzing tools for diagnosis of high voltage insulation like PD pattern recognition, statistical evaluations may be provided.		
3.2.10		<b>Accessories and Spares</b>  The following accessories and spares shall be provided as standard package and included in the scope of supply;		
4		<b>Tests and Calibration:</b> 1. The supplier shall conduct appropriate tests (routine and functional) on individual components of the series resonant test and partial discharge measuring system to ensure compliance with the specifications and relevant applicable standards. Detailed test reports shall be supplied for review during the inspection at supplier's works before dispatch and shall form as a part of overall documentation package. Some of the tests as applicable shall be performed on the major components are listed below:  • DSIT: a) Turns ratio measurement for all windings b) Excitation current and no load loss c) Short circuit impedance measurement d) Applied potential test between windings and shield at the appropriate specified test levels • RT: a) Excitation current and no load loss b) Short circuit impedance measurement c) Minimum and Maximum output voltage with rated voltage applied on no load • LVF: a) Signal attenuation in frequency band specified • Power cubicle and controls:a) Functional tests of all overload protection devices b) operational tests of all devices c) Functionality of all control circuits, overloads and safety interlocks d) Calibration of all measuring displays according to IEC requirements • ET: a) Voltage ratio measurement for each output tap b) Excitation current and no load loss c) Short circuit impedance measurement for each output tap d) DC winding resistance d)		
		2. The supplier shall carry out all type, routine test, performance tests, performance checks and additional capabilities as sought in the specifications on capacitor voltage divider, Coupling capacitor and the measuring instrument in accordance with IEC 60060-2 (latest version)measurement of voltages including the PD measurement of the capacitor units. The performance of the overall high voltage measuring system shall comply with this standards and supplier should furnish the documents for the traceability of calibration with IEC 17025 accreditation laboratory.		
		3. The supplier shall carry out all type, routine test, performance tests, performance checks and additional capabilities as sought in the specifications for PD measuring systemand the calibrator as per IEC 60270/2000, Clause 7.The performance of the overall PD and RIV measuring system along with calibrator shall comply with this standard and supplier should furnish the documents for the traceability of calibration with IEC 17025 accreditation laboratory. 4. Calibration certificates for all other measuring instrument shall be submitted for approval.		

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5		<p><b>Pre Dispatch Inspection</b></p> <p>The supplier shall submit the routine, type, special and calibration test reports of the individual components as well as overall system as detailed in Sl. No. 14 above for review during Pre Dispatch Inspection (PDI) to be carried out at the works of the supplier or at any specified location as agreed. Further, PDI will be carried out subject to the satisfactory compliance of all the test and calibration reports in accordance with the relevant standards. The supplier shall conduct the following tests in the presence of CPRI representatives at the manufacturers' works as a part of PDI:</p> <ul style="list-style-type: none"> <li>• Functional tests of all overload protection devices</li> <li>• Operational tests of all devices</li> <li>• Functionality of all control circuits, overloads and safety interlocks</li> <li>• Overvoltage tests at 110% of rated output for 5 minutes with voltage divider and coupling capacitor with blocking impedance connected</li> <li>• Three repeated flashover tests at rated voltage through an external gap directly to ground with base load connected.</li> <li>• PD measurements at rated output voltage performed after overvoltage and flashover tests</li> <li>• PD measurement at 100% rated voltage followed by measurement at rated output voltage for the duty cycle assigned with voltage divider and coupling capacitor connected.</li> </ul>		
		<b>The Delivery Instructions are subject to the compliance of all the test and calibration reports in accordance with the relevant standards and satisfactory completion of PDI.</b>		
6		<p><b>Qualifying Conditions :</b></p> <p>1. The vendor, who or their principals have at least 10 year experience in manufacturing of such type of system.</p> <p>2. The vendor should have supplied and commissioned at least one set of AC HV series resonance test system having rating at least 400kV/ 1200kVA or higher in the past five years and such system shall be presently working satisfactorily for more than three years. The vendor shall submit the document giving details Viz., Name of the customer/ company where similar system is installed, complete postal address of the customer, Year of commissioning &amp; commissioning report, Name of the contact person with designation, Phone No. &amp; email address and performance certificate.</p>		
7		<p><b>Installation, Commissioning and Training :</b></p> <ul style="list-style-type: none"> <li>• The installation and commissioning of all components of the Series Resonant Test and PD measuring system along with trial testing at rated test voltage with basic loads shall be carried out by the supplier. The supplier shall provide operation, maintenance and troubleshooting training to CPRI representatives for three main days.</li> </ul>		
8		<p><b>Documents and Drawings :</b></p> <p>The scope of supply shall also include three sets of all relevant technical specifications and drawings detailing the constructional features, operating instructions and maintenance schedule etc. of all components of the test and measuring system. All the documents and communication shall be in ENGLISH .</p>		
9		<p><b>Guarantee :</b></p> <p>The Series Resonant Test and PD measuring system shall be guaranteed to perform in accordance with the specifications of CPRI and against defective material design and workmanship. The guarantee period shall be 18 (Eighteen) months from the date of receipt of all the equipment / materials at CPRI, Bhopal or 12 months from the date of commissioning whichever is earlier.</p>		
10		<p><b>Delivery Period :</b></p> <p>All the instruments / equipment for the Series Resonant Test and PD measuring system shall be supplied to STDS, CPRI, Bhopal Madhya Pradesh, India. The delivery period should be 8 to 10 months from the date of clear purchase order.</p>		
11		<p><b>Payment Terms :</b></p> <p>The supplier shall quote the payment terms, mode of dispatch, freight and insurance etc.</p>		
12		<p><b>Validity of Offer :</b></p> <p>The offer shall be valid for six months in order to obtain the necessary clearances for the purchase / import of the equipment.</p>		

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		<b>Remark : All the items shall be quoted seperately with the model No. of the specific item.</b>		
		<b>The system supplied shall cover the test and the equipments covered in the scope of supply.</b>		
13		<b>Note:</b> a) Offers quoted in the above format will only be considered. b) Each page of the offer shall contain signature and seal of the bidder. c) Firms meeting the qualifying conditions only are eligible to quote. d) The quotation shall include detailed diagrams of each component, necessary circuit diagrams of the test system, floor area layout, necessary electrical clearance, etc. e) Necessary Catalogues / Brochures to be enclosed. Reference to the Catalogues / Brochures in the offer shall clearly mention the Item Number, Clause, Table, Page Number, Figures etc., and appropriately highlighted in the Catalogues / Brochures. f) The bidder shall specify the area of laboratory building with clear dimensional drawing to house the test source (High voltage system complete) along with test samples inside laboratory building with safety clearances. The bidder is also required to submit the details of earthing/shielding network and type of earthing / shielding etc. to CPRI for the execution by CPRI. g) The bidder shall give the details of power supply requirement for installation and commissioning at rated test power. h) All civil works for the construction of laboratory building, electrical fittings, water supply along with handling facilities etc. will be done by CPRI with a separate agency / supplier.		
PN: 1. A detailed technical catalogue/phamlet and other details shall be sent in hard copy in a sealed cover super scribing tender enquiry number and due date so 2. Letter of authorization issued by the principal shall be sent by the Indian agents who have offered on behalf of their principals. <b>Address : Joint Director</b> <b>Central Power Research Institute</b> <b>Govindpura, Bhaopal- 462023</b>				